



BANGLADESH TECHNICAL EDUCATION BOARD

Agargaon, Sher-E-Bangla Nagar

Dhaka-1207.

**04-YEAR DIPLOMA IN ENGINEERING CURRICULUM
COURSE STRUCTURE & SYLLABUS
(PROBIDHAN-2022)**

POWER TECHNOLOGY

TECHNOLOGY CODE: 71

3rd SEMESTER

(Effective from 2022-2023 Academic Sessions)

DIPLOMA IN ENGINEERING CURRICULUM COURSE STRUCTURE

(PROBIDHAN-2022)

TECHNOLOGY NAME: POWER TECHNOLOGY (71)

(3RD SEMESTER)

Sl. No.	Subject		Period Per Week		Credit	Marks Distribution						
						Theory Assessment			Practical Assessment			Grand Total
	Code	Name	Theory	Practical		Continuous	Final	Total	Continuous	Final	Total	
1	25922	Physics-II	3	3	4	60	90	150	25	25	50	200
2	25931	Mathematics-III	3	3	4	60	90	150	25	25	50	200
3	26811	Basic Electronics	2	3	3	40	60	100	25	25	50	150
4	27012	Machine Shop Practice- I	1	6	3	20	30	50	50	50	100	150
5	27131	Engineering Thermodynamics	3	3	4	60	90	150	25	25	50	200
6	27231	RAC Cycles & Components	2	3	3	40	60	100	25	25	50	150
Total			14	21	21	280	420	700	175	175	350	1,050

Subject Code	Subject Name	Period per Week		Credit
25922	PHYSICS-II	T	P	C
		3	3	4

Rationale	Physics is the basic science for all engineering students as well as diploma engineering students. To develop a foundation in scientific principles and processes for the understanding and application of various technology. It will help the students to study in technical subject of diploma engineering students.
Learning Outcome (Theoretical)	After undergoing the subject students will be able: 1. Identify and classify various types of source of heat and temperature. Describe determination procedure temperature of materials and heat capacity of solid and liquid. 2. Describe second law of thermodynamics, heat engine. 3. Describe static electricity current electricity, magnetism, reflection of light. Refraction of light, photoelectric effect, structure of atom, Theory of relativity, semiconductor and electronics.
Learning Outcome (Practical)	After undergoing the subject (Practical) the students will be able to: 1. Compare the operation of common thermometers. 2. Determine the co-efficient of linear expansion of solid. 3. Measure the specific heat capacity of Brass, steel etc. 4. Determine the latent heat of fusion of ice. 5. Verify the Ohm's Law. 6. Determine the Mechanical Equivalent of Heat by using Joule's Calorimeter. 7. Verify the laws of reflection. 8. Find out the focal length of a concave mirror. 9. Determine the refractive index of a glass slab 10. Determine the angle of minimum deviation & refractive index of prism.

Detailed Syllabus (Theory)

Unit	Topics with Contents	Class (1 Period)	Final Marks
1.	THERMOMETRY 1.1 Define Heat & Temperature 1.2 Mention the unit of Heat & Temperature 1.3 Relate between different scale of Temperature 1.4 State the construction and graduation of mercury Thermometer 1.5 Define specific heat, thermal capacity and water equivalent 1.6 Mention units of specific heat, thermal capacity and water equivalent 1.7 Explain the principle of Calorimetry, 1.8 Discuss various kinds of specific latent heat	3	5
2	EFFECT OF HEAT ON MATERIALS 2.1 Define linear, superficial and cubical expansion of solid. 2.2 Define Coefficient of linear, superficial and cubical expansion of solid. 2.3 Relate between coefficient of linear, superficial and cubical	4	7

	<p>expansion of solid.</p> <p>2.4 Explain the methods of heat transfer by conduction, convection and Radiation with example.</p> <p>2.5 Define Thermal conductivity and Coefficient of the thermal conductivity</p> <p>2.6 List the factors which determine the quantity of heat (Q) flowing through a material and Show that the quantity of heat flowing through a material can be found</p> <p>from $Q = \frac{KA(\theta_H - \theta_C)t}{d}$</p> <p>2.7 State Stefan-Boltzman Law.</p> <p>2.8 State Newton's law of cooling.</p> <p>2.9 State wine's law.</p> <p>310 Explain Greenhouse effect.</p>		
3	<p>NATURE OF HEAT AND MECHANICAL EQUIVALENT</p> <p>3.1 Describe the caloric theory and kinetic theory of heat</p> <p>3.2 State the limitation of the caloric theory of heat</p> <p>3.3 Explain the mechanical equivalent of heat</p> <p>3.4 Explain the first law of thermodynamics</p> <p>3.5 Explain Isothermal and adiabatic change.</p> <p>3.6 Describe Specific heat of a gas, Molar specific heat or molar heat capacity.</p> <p>3.7 Relate between pressure and volume of a gas in adiabatic change i, e; $PV^\gamma = \text{const.}$</p> <p>3.8 Relate between C_p and C_v for and ideal gas ($C_p - C_v = R$)</p>	4	6
4	<p>SECOND LAW OF THERMODYNAMICS</p> <p>4.1 Explain Reversible process and irreversible process.</p> <p>4.2 Explain 2nd law of thermodynamics</p> <p>4.3 Define heat engine</p> <p>4.4 Explain the principle of Carnot's cycle</p> <p>4.5 Mention the formula thermal efficiency of a heat engine</p> <p>4.6 Distinguish between internal combustion engine and external combustion engine.</p> <p>4.7 Describe Entropy</p> <p>4.8 Mention the significant of entropy</p> <p>4.9 Describe Change of entropy in a reversible and irreversible process.</p>	4	6
5	<p>ELECTROSTATIC</p> <p>5.1 Define Charge and Nature of charge.</p> <p>5.2 State the Law of attraction and repulsion of charge.</p> <p>5.3 Explain the Coulomb's Law</p> <p>5.4 Define Electric field and electric intensity.</p> <p>5.5 Define Electric Potential and Potential difference</p> <p>5.6 Relate between electric intensity and electric Potential.</p> <p>5.7 Define Capacitor and capacitance.</p> <p>5.8 Explain Energy of Capacitor.</p> <p>5.9 Mention the Uses of capacitor.</p>	3	5
6	<p>MAGNETISM</p> <p>6.1 Describe Earth's Magnetism.</p> <p>6.2 Define Magnet, Magnetic Substance, Non-magnetic Substance, Magnetic Pole</p> <p>6.3 Define Magnetic field, Magnetic Intensity.</p> <p>6.4 Explain Magnetic Permeability, Magnetic Susceptibility</p> <p>6.5 Explain Declination & inclination, Horizontal Component of</p>	4	7

	<p>Earth's Magnetic field B_H or H of Magnetic Elements of Earth</p> <p>6.6 Classify Magnetic Materials</p> <p>6.7 Compare among Diamagnetic, Paramagnetic and Ferromagnetic substance.</p> <p>6.8 Describe Magnetic Domain.</p>		
7	<p>REFLECTION OF LIGHT</p> <p>7.1 Define mirror (plane and spherical), image (real and virtual) and magnification.</p> <p>7.2 Classify mirror and image</p> <p>7.3 Describe the reflection of light</p> <p>7.4 State the laws of reflection of right</p> <p>7.5 Describe the verification of laws of reflection</p> <p>7.6 Define pole, principal axis, center of curvature, radius of curvature, Principal focus in case of concave and convex mirrors</p> <p>7.7 Express the general equation of concave and Convex mirror</p> <p>7.8 Mention the uses of mirror and identify of Mirror.</p>	3	6
8	<p>REFRACTION OF LIGHT</p> <p>8.1 Describe refraction of light</p> <p>8.2 State the laws of refraction</p> <p>8.3 Express the verification of laws of refraction</p> <p>8.4 Describe critical angle and total internal refract reflection.</p> <p>8.5 Relate between refractive index, minimum deviation of angle of the prism.</p> <p>8.6 Define lens</p> <p>8.7 Mention the kinds of lens.</p> <p>8.8 Define center of curvature, radius of Curvature, Principal axis, first and second Principal focus, Optical center.</p> <p>8.9 Derive general equation of the lens (Concave and convex)</p> <p>8.10 Explain power of lens and equivalent of lens.</p>	3	8
9	<p>PHYSICAL OPTICS</p> <p>9.1 Describe Electromagnetic Wave</p> <p>9.2 Define Poynting Vector</p> <p>9.3 Describe Electromagnetic Spectrum</p> <p>9.4 Mention the wavelength of visible light spectrum</p> <p>9.5 Define Light Year</p> <p>9.6 Define Wave and Wave front</p> <p>9.7 State the Huygens' Principle</p> <p>9.8 Define Coherent Source</p> <p>9.9 Define Interference of Light, Diffraction of Light and Polarization of Light.</p> <p>9.10 Classify Interference of Light, Diffraction of Light and Polarization of Light.</p>	4	8
10	<p>PHOTO ELECTRIC EFFECT</p> <p>10.1 Describe Electrical conductivity of gases.</p> <p>10.2 Describe Discharge tube.</p> <p>10.3 Define Cathode ray and X- Ray</p> <p>10.4 Mention the properties of Cathode ray and X- Ray</p> <p>10.5 Mention the use of X- Ray</p> <p>10.6 Discuss photo electric effect</p> <p>10.7 Derive Einstein's photo electric equation.</p>	4	6

11	STRUCTURE OF ATOM 11.1 Describe the concept of structure of Atom 11.2 Discuss Thomson of Atomic models 11.3 Discuss Rutherford model of Atomic models 11.4 Discuss Bohr model of Atomic models 11.5 Derive the equation of Radius and Energy by using Bohr model 11.6 Explain Energy level of Electron 11.7 Derive the frequency of Photon by using Hydrogen atom Spectrum	3	6
12	NUCLEAR PHYSICS 12.1 Explain radioactivity 12.2 Describe radioactive rays 12.3 Deduce Radioactive decay law 12.4 Define half- life and mean-life of radioactive atom 12.5. Relate between half-life and radioactive decay constant 12.6 Describe Nuclear Reactor 12.7 Explain nuclear fission & fusion.	3	7
13	MODERN PHYSICS 13.1 Describe the concept of Modern Physics 13.2 Discuss about Reference frame 13.3 Explain Inertial and Non-Inertial Reference 13.4 Describe reference frame and Motion 13.5 Postulates of special Theory of Relativity 13.6 Explain the Galilean Transformation 13.7 Describe Lorentz Transformation 13.8 Define Black Holes and black body radiation.	3	7
14	THEORY OF RELATIVITY AND ASTRO PHYSICS 14.1 Describe Relativity 14.2 Discuss the types of Relativity 14.3 Explain Einstein's theory of Relativity 14.4 Describe the Relativity of time: Time Dilation 14.5 Discuss Relativity of Length : Length Contraction 14.6 Discuss Relativity of mass 14.6 Relate between mass and Energy ($E=mc^2$)	3	6
Total		48	90

Detailed Syllabus (Practical)

Unit	Topics with Contents	Class (3 Period)	Continuous Marks
1	COMPARE THE OPERATION OF COMMON THERMOMETERS 1.1 Observe the different types of thermometer 1.2 Apply relation formula 1.3 Measure the temperature of liquid such normal water, hot water & ice 1.4 Calculate and compare the operation of thermometer 1.5 Maintain the record of the performance of experiment.	1	1

2	<p>DETERMINE THE CO-EFFICIENT OF LINEAR EXPANSION OF A SOLID BY PULLINGER'S APPARATUS</p> <p>2.1 Collect Pullinger's Apparatus , Thermometer and screw gauge</p> <p>2.2 Apply heat to boil producer</p> <p>2.3 Calculate the Linear expansion of solid</p> <p>2.4 Maintain the record of the performance of experiment.</p>	1	1
3	<p>MEASURE THE SPECIFIC HEAT CAPACITY OF VARIOUS SUBSTANCES. (BRASS, STEEL)</p> <p>3.1 Collect Calorimeter, Thermometer, Brass, Balance</p> <p>3.2 Apply the formula for specific heat</p> <p>3.3 Measure various terms according to formula</p> <p>3.4 Calculate Specific heat capacity</p> <p>3.5 Maintain the record of the performance of experiment.</p>	1	2
4	<p>DETERMINE THE LATENT HEAT OF FUSION OF ICE</p> <p>4.1 Collect Calorimeter, Thermometer, Brass, Balance and ice</p> <p>4.2 Apply the formula for latent heat of fusion</p> <p>4.3 Measure various terms according to formula</p> <p>4.4 Calculate latent heat of fusion</p> <p>4.5 Maintain the record of the performance of experiment.</p>	1	2
5	<p>DETERMINE THE LATENT HEAT OF FUSION OF ICE</p> <p>5.1 Collect Calorimeter, Thermometer, Brass, Balance and Vapor producer</p> <p>5.2 Apply the formula for latent heat of Vapor</p> <p>5.3 Measure various terms according to formula</p> <p>5.4 Calculate latent heat of fusion</p> <p>5.5 Maintain the record of the performance of experiment.</p>	1	2
6	<p>DETERMINE THE MECHANICAL EQUIVALENT OF HEAT BY USING JOULE'S CALORIMETER</p> <p>6.1 Collect Joule's Calorimeter, Thermometer, Voltmeter</p> <p>6.2 Apply Joule's formula for heat equivalent</p> <p>6.3 Measure various terms according to formula</p> <p>6.4 Determine the Mechanical Equivalent of Heat</p> <p>6.5 Maintain the record of the performance of experiment.</p>	2	2
7	<p>VERIFY THE LAWS OF REFLECTION</p> <p>7.1 Collect Plane mirror, pin and drawing board</p> <p>7.2 Apply the laws of reflection</p> <p>7.3 Measure the incident angle and reflection angle</p> <p>7.4 Verify the laws of reflection</p> <p>7.5 Maintain the record of the performance of experiment.</p>	2	4
8	<p>FIND OUT THE FOCAL LENGTH OF A CONCAVE MIRROR</p> <p>8.1 Collect Optical bench & concave mirror</p> <p>8.2 Apply focal length formula.</p>	2	4

	8.3 Measure the object length & Image length 8.4 calculate the focal length by using formula 8.5 Maintain the record of the performance of experiment.		
9	DETERMINE THE REFRACTIVE INDEX OF A GLASS SLAB 9.1 Collect glass slab, pin, drawing paper and drawing board 9.2 Apply the Snell's law 9.3 Measure incident and refractive angle 9.4 calculate the refractive index 9.5 Maintain the record of the performance of experiment.	3	4
10	DETERMINE THE ANGLE OF MINIMUM DEVIATION AND REFRACTIVE INDEX OF A GLASS PRISM BY USING 1-D GRAPH 10.1 Collect prism, pin, drawing paper and drawing board 10.2 Apply the laws of minimum deviation 10.3 Measure incident angle and minimum deviation 10.4 Calculate the refractive index of prism 10.5 Maintain the record of the performance of experiment.	2	3
	Total	16	25

Recommended Books:

Sl	Book Name	Writer Name
	REFERENCE BOOKS: 1. Higher Secondary Physics - Second Part 2. A Text Book of Heat and Thermodynamics 3. A Text Book of Optics 4. Higher Secondary Physics - Second Part 5. Higher Secondary Physics -Second Part 6. Thermodynamics	- by Dr. Shahjahan Tapan - by N Subrahmanyam and Brij Lal - by N Subrahmanyam and Brij Lal - by Prof. Golam Hossain Pramanik - by Ishak Nurun Nabi - by K K Ramalingam

Website References:

Sl	Web Link	Remarks
1	www.nctb.gov.bd	

Subject Code	Subject Name	Period per Week		Credit
25931	Mathematics-III	T	P	C
		3	3	4

Rationale	To be able to understand the binomial expansion. To enable to calculate the areas of regular polygons, hexagons, octagon, hydraulic mean a depth (HMD) of a Channel, area occupied by water of circular Culvert. Excavation work. To provide the ability to calculate volume of regular solids like pyramid, frustum of pyramid, Prismoid, wedge and area of curved surfaces. To understand the Laplace transformation
Learning Outcome (Theoretical)	Express Binomial expansion. To able to find the area triangle, quadrilateral, parallelogram, regular polygon & circle volume of solid Shaped. Able to solve problems related to area & volume of various type of shaped.
Learning Outcome (Practical)	Able to solve problems related to area and volume of various type of shaped.

Detailed Syllabus (Theory)

Unit	Topics with Contents	Class (1 Period)	Final Marks
1	<p>MENSURATION(Area of Triangle):</p> <p>1.1 Find the area of triangle in the form, $A = \frac{\sqrt{3}}{4} a^2$, a = length of a side of equilateral triangle. $A = \frac{c}{4} \sqrt{4a^2 - c^2}$, where a = length of equal sides, c = third side. $A = \sqrt{s(s-a)(s-b)(s-c)}$, where a, b, c = length of the sides of a Triangle and 2s is the perimeter of the triangle.</p> <p>1.2 Use formula in 1.1 to solve problems.</p>	4	8
2	<p>MENSURATION (Areas of quadrilateral, Parallelogram, rhombus & trapezium)</p> <p>2.1 Define quadrilateral & Parallelogram. 2.2 Find the areas of quadrilateral when off sets are given. 2.3 Find the areas of a parallelogram. 2.4 Solve problems using above formulae. 2.5 Define rhombus & trapezium. 2.6 Find the areas of rhombus when the diagonals are given. 2.7 Find the areas of trapezium in terms of its parallel sides and the perpendicular distance between them. 2.8 Solve problems related to rhombus & trapezium.</p>	3	6
3	<p>MENSURATION(Finding areas of regular polygon):</p> <p>3.1 Define a regular polygon. 3.2 Find the area of a regular polygon of n sides, when (i) The length of one side and the radius of inscribed circle are given. (ii) The length of one side and the radius of circumscribed circle are given. 3.3 Find the area of a regular. a) Hexagon, Octagon when length of side is given.</p>	3	6

Unit	Topics with Contents	Class (1 Period)	Final Marks
	3.4 Solve problems of the following's types: A hexagonal polygon 6 m length of each side has a 20 cm width road surrounded the polygon. Find the area of the road.		
4	MENSURATION(Areas of circle, sector and segment): 4.1 Define circle, circumference, sector and segment. 4.2 Find the circumference and area of a circle when its radius is given. 4.3 Find the area of sector and segment of a circle. 4.4 Solve problems related to the above formulae.	3	6
5	MENSURATION(Area & Volume of a rectangular solid): 5.1 Define rectangular solid and a cube. 5.2 Find geometrically the volume of a rectangular solid when its length, breadth and height are given. 5.3 Find the volume and diagonal of a cube when side is given. 5.4 Solve problems with the help of 5.2 & 5.3.	3	5
6	MENSURATION(Surface area & volume of a prism): 6.1 Define a prism. 6.2 Explain the formulae for areas of curved surfaces of prism. 6.3 Explain the formulae for volume of prism when base and height are given. 6.4 Solve problems related to 6.2, 6.3	3	5
7	MENSURATION (Area & volume of Parallelepiped and cylinder): 7.1 Define a parallelepiped and a cylinder. 7.2 Explain the formulae for areas of curved surfaces of parallelepiped and cylinder. 7.3 Explain the formulae for volume of parallelepiped and cylinder when base and height are given. 7.4 Solve problems related to 7.1, 7.2, 7.3	3	5
8	MENSURATION (Surface area & volume of pyramid): 8.1 Define pyramid. 8.2 Explain the formula for areas of curved surfaces of pyramid. Explain the formula for volumes of pyramid. 8.3 Solve problems related to 8.2, 8.3	2	4
9	MENSURATION (Surface area & volume of cone and sphere): 9.1 Define cone and sphere. 9.2 Explain the formula for areas of curved surfaces of cone and sphere. 9.3 Explain the formula for volumes of cone and sphere. 9.4 Solve problems related to 9.2, 9.3	3	5
10	GEOMETRY: Conic or conic sections: 1.1 Define Conic, Focus, Directorix and Eccentricity. 1.2 Find the equations of Parabola, Ellipse and Hyperbola. 1.3 Solve problems related to Parabola, Ellipse and Hyperbola.	3	5
11	CALCULAS (Differential Equations of first order and first degree): 11.1 Define differential equation, ordinary & partial differential equation.	4	7

Unit	Topics with Contents	Class (1 Period)	Final Marks
	11.2 Define order and degree of differential equation. 11.3 Solve the differential equations of the form: Variable separable.		
12	CALCULAS (Differential Equations of first order and first degree of homogeneous equations): 12.1 Define Homogeneous equation & Homogeneous differential equation. 12.2 Define order and degree of differential equation. 12.3 Solve the differential equations of the form: Homogeneous equation.	3	5
13	CALCULAS (First order and first degree of Exact differential equations): 13.1 Define Exact differential equation. 13.2 Define integrating factor. 13.3 Solve problems related to Exact differential equations.	3	5
14	CALCULAS (First order and first degree of Linear differential equations): 14.1 Define Linear differential equation. 14.2 Define integrating factor, Bernoulli's equation. 14.3 Solve problems related to Linear differential equations.	4	8
15	CALCULAS (Laplace Transformation): 15.1 Define Laplace transformation in the form $F(S) = \int_0^{\infty} f(t)e^{-st}dt$ 15.2 Express the deduction of Laplace transformation of the following functions. (i) Constant (ii) t (iii) t^n (iv) e^{at} (v) $\sin at$ (vi) $\cos at$ (vii) $e^{at} t^n$ (viii) $e^{at} \sin bt$ (ix) $e^{at} \cos bt$ 15.3 Define inverse Laplace transformation 15.4 Solve problem related to 15.1, 15.2, 15.3	4	8
	Total	48	90

N.B. Marks allotted per chapter above may be rearranged if necessary.

Detailed Syllabus (Practical)

SL	Experiment name with procedure	Class (3 Period)	Continuous Marks
01	Find out the area of triangle	1	2
02	Find out the areas of quadrilateral, parallelogram, rhombus & trapezium	2	3
03	Calculate the areas of regular polygon	1	2
04	Calculate the areas of circle, sector and segment	2	3
05	Find out the area & volume of a rectangular solid	1	2
06	Calculate the surface area & volume of a prism	2	3
07	Find out the area & volume of cylinder	1	2
08	Calculate the surface area & volume of pyramid	2	2
09	Find out the surface area & volume of cone and sphere	1	2
10	Solve the problems related to conic sections & differential equation	3	4

SL	Experiment name with procedure	Class (3 Period)	Continuous Marks
01	Find out the area of triangle	1	2
02	Find out the areas of quadrilateral, parallelogram, rhombus & trapezium	2	3
03	Calculate the areas of regular polygon	1	2
04	Calculate the areas of circle, sector and segment	2	3
05	Find out the area & volume of a rectangular solid	1	2
06	Calculate the surface area & volume of a prism	2	3
07	Find out the area & volume of cylinder	1	2
08	Calculate the surface area & volume of pyramid	2	2
09	Find out the surface area & volume of cone and sphere	1	2
10	Solve the problems related to conic sections & differential equation	3	4
	Total	16	25

N.B. Marks allotted per chapter above may be rearranged if necessary.

Necessary Resources (Tools, equipment's and Machinery):

SL	Item Name	Quantity
01	Scale	1 no
02	Geometric Box	1 no

Recommended Books:

Sl	Book Name	Writer Name	Publisher Name & Edition
1.	Companion to basic Maths	G. V. Kumbhojkar	Phadke Prakashan
2.	Co-ordinate Geometry & Vector Analysis	Rahman & Bhattacharjee	H.L. Bhattacharjee
3.	Higher Mathematics	Md. Nurul Islam	Akkhar Patra Prakashani
4.	Mathematics for Polytechnic Students	S. P Deshpande	Pune Vidyarthi Graha Prakashan
5.	Mathematics for Polytechnic Students (Volume I)	H. K. Das	S.Chand Prakashan
6.	Engg.Maths Vol I & II	Shri Shantinarayan	S.Chand & Comp
7.	Higher Mathematics	Dr. B M Ekramul Haque	Akshar Patra Prakashani
8.	Differential & Integral Calculus	Md. Abu Yousuf	Mamun Brothers

Website References:

SL	Web Link: www.youtube.com	Remarks
----	--	---------

Subject Code	Subject Name	Period per Week		Credit
26811	BASIC ELECTRONICS	T	P	C
		2	3	3

Rationale	Electronic devices have become an important part of our day-by-day life. Now a days it is difficult for us to live without electronic device. We live in a generation that uses electronics and smart technologies. Where robots and artificial intelligence is capable of doing human works in all technological equipment with more ease and efficiency. Operation of all machines, devices and equipment are controlled by electronic device and circuits. This subject covers only such topics which will enable the diploma engineers to identify and maintenance the electronics parts and able to proper fault finding.
Learning Outcome (Theoretical)	<p>After undergoing the subject, students will be able to:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Describe soldering <input type="checkbox"/> Determine the value of Capacitor & Resistor using numeric and color code. <input type="checkbox"/> Describe Semiconductor and Semiconductor Diode. <input type="checkbox"/> Describe Rectifier circuits <input type="checkbox"/> Explain Construction and characteristics of PNP and NPN Transistor. <input type="checkbox"/> Explain the construction and operation of Single and Multi stage amplifier
Learning Outcome (Practical)	<p>After undergoing the subject, students will be able to:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Perform soldering. <input type="checkbox"/> Calculate values of different resistors and capacitors with the help of color code. <input type="checkbox"/> Check the semiconductor diode and Determine characteristics of Diode <input type="checkbox"/> Verify the wave-shape of half-wave and full wave rectifier circuit <input type="checkbox"/> Test special diodes. <input type="checkbox"/> Verify the bipolar junction transistor characteristics. <input type="checkbox"/> Determining Q-Point and gain of transistor amplifier. <input type="checkbox"/> Determining frequency response of single stage R-C coupled transistor amplifier.

Detailed Syllabus (Theory)

Unit	Topics with Contents	Class (1 Period)	Final Marks
1.	SOLDERING AND COLOR CODE 1.1 Define soldering. 1.2 List the materials of soldering. 1.3 Describe the steps of soldering. 1.4 Mention the properties of a good soldering joint. 1.5 Describe the active and passive components used in electronic circuits. 1.6 Mention the function of resistor, capacitor and inductor in electronic circuits. 1.7 Describe the procedure of determining the value of Capacitor, & Resistor using numeric and color code.	3	4
2	SEMICONDUCTOR 2.1 Define conductor, semiconductor and insulator. 2.2 Describe semiconductor with atomic structure. 2.3 Describe the effect of temperature on conductivity of Semiconductor. 2.4 Classify Semiconductor. 2.5 List the commonly used semiconductor 2.6 Describe the formation of P-type and N-type semiconductor. 2.7 Describe the charges on N-type and P-type Semiconductor 2.8 Explain the majority & minority charge carriers of P-type & N-Type Semiconductor.	3	4
3	SEMICONDUCTOR DIODE 3.1 Define PN junction diode 3.2 Describe the formation of PN junction. 3.3 Explain forward and reverse bias in PN junction. 3.4 Explain the forward and reverse Voltage-Current (VI) characteristics curve of PN junction diode. 3.5 Define load line, static resistance, (iii) dynamic resistance, 3.6 Define forward breakdown voltage, (v) Peak inverse voltage (PIV) and (vi) Reverse break down voltage. 3.7 Describe the specification of PN Junction diode.	3	4
4	SPECIAL DIODES 4.1 Define Zener Diode. 4.2 Describe the operation of Zener diode. 4.3 Explain Volt-Ampere(VI) characteristics of Zener diode. 4.4 Describe the application of Zener diode in, voltage stabilization, meter protection and peak clipper circuits. 4.5 Describe the construction, operation and application of Tunnel diode, Varactor diode,	3	4

	Schottky diode, Step-Recovery diode, PIN diode, LED, LCD, photo diode and Solar cell.		
5	<p>DC POWER SUPPLY</p> <p>5.1 Define dc power supply</p> <p>5.2 Describe importance of dc power supply .</p> <p>5.3 Compare regulated and unregulated power supply.</p> <p>5.4 Describe the operation of a typical regulated dc power supply with block diagram.</p> <p>5.5 Define rectifier and rectification.</p> <p>5.6 Explain the operation of half wave, full wave and bridge rectifier circuit.</p> <p>5.7 Determine the ripple factor, efficiency and TUF of half wave, full wave and bridge rectifier.</p> <p>5.8 Explain the operation of capacitor; inductor-capacitor and pi (π) filter circuit.</p> <p>5.9 Solve problem related to ripple factor, efficiency and TUF.</p>	3	8
6	<p>BIPOLAR JUNCTION TRANSISTOR (BJT)</p> <p>6.1 Define Transistor.</p> <p>6.2 Describe the construction of PNP and NPN Transistor.</p> <p>6.3 Explain the mechanism of current flow of PNP and NPN Transistor.</p> <p>6.4 State the biasing rules of BJT.</p> <p>6.5 Establish the relation among Base, Emitter and Collector current ($I_E = I_C + I_B$).</p>	2	4
7	<p>Transistor Characteristics</p> <p>7.1 Describe three basic transistor configuration (CB, CC, CE) circuits.</p> <p>7.2 Explain the characteristics curve of CB, CC and CE transistor configurations.</p> <p>7.3 Describe current amplification factor α, β and γ.</p> <p>7.4 Establish the relation among α, β and γ.</p> <p>7.5 Solve problem related to I_E, I_C, I_B, α, β and γ</p>	3	4
8	<p>TRANSISTOR BIASING AND STABILIZATION</p> <p>8.1 Define load line, Operating point, stability and stabilization.</p> <p>8.2 State the biasing rule of transistor.</p> <p>8.3 Describe faithful amplification.</p> <p>8.4 Describe the methods of drawing DC load line.</p> <p>8.5 Explain the leakage current in CB & CE circuits.</p> <p>8.6 List the factors affecting stability of Q-points.</p> <p>8.7 Describe various methods of transistor biasing.</p> <p>8.8 Determine the stability factor of various transistor biasing circuits.</p> <p>8.9 Solve problem related to components values, Q-Points and stability factor.</p>	4	8

9	SINGLE STAGE TRANSISTOR AMPLIFIER 9.1 Define amplifier and single stage amplifier. 9.2 Mention the types of amplifier. 9.3 Explain operation of transistor as amplifier with graphical demonstration. 9.4 Describe the operation of voltage divider biased CE amplifier circuit. 9.5 Explain the phase reversal of CE amplifier. 9.6 Draw DC and AC equivalent circuit of voltage divider biased CE amplifier circuit. 9.7 Determine the AC equivalent load resistance of the CE amplifier circuit. 9.8 Determine voltage and power gain of the CE amplifier circuit. 9.9 Solve problem related to voltage and power gain where β and input resistance of the transistor are given.	4	10
10	MULTISTAGE TRANSISTOR AMPLIFIER 10.1 Define Multi stage amplifier. 10.2 Describe role of capacitor in single stage amplifier. 10.3 Describe gain, decibel gain frequency response, half power point, 3db point and bandwidth. 10.4 Mention the advantages of dB gain. 10.5 Describe the operation of RC coupled, Transformer coupled and direct coupled multistage amplifier. 10.6 Explain the frequency response of RC coupled, Transformer coupled and direct coupled multistage amplifier. 10.7 Mention the advantages and disadvantages of RC coupled, Transformer coupled and direct coupled multistage amplifier. 10.8 Solve problem related to voltage and power gain where β and input resistance of the transistor are given.	4	10
Total		32	60

Detailed Syllabus (Practical)

Unit	Experiment name with procedure	Class (3 Period)	Continuous Marks
1	Solder & de-solder of electronic components and wires to the other components and circuit boards. 1.1. Select electronic components, wires and PCB. 1.2. Select the rating of the soldering iron suitable for the work piece. 1.3. Clean and tin both iron & work piece. 1.4. Feed new soldering materials to the tinned and	1	3

	<p>heated joint in order to produce a correct soldering.</p> <p>1.5. Check the quality of soldering.</p> <p>1.6. Clean and tin iron and de-solder the joint and components.</p> <p>1.7. Use solder suckers and solder braid for de-soldering.</p> <p>1.8. Maintain the record of performed job.</p>		
2	<p>Determine the values of different resistors, capacitors and inductor.</p> <p>2.1 Select resistors, capacitors and inductors of different values.</p> <p>2.2 Identify the colors or numeric code</p> <p>2.3 Determine the value of resistors, capacitor and inductor with tolerance. .</p> <p>2.4 Maintain the record of performed job.</p>	1	2
3	<p>Sketch forward and reverse characteristics curves of a semiconductor diode.</p> <p>3.1 Select meter, power supply, components and materials.</p> <p>3.2 Complete circuit according to circuit diagram for forward bias.</p> <p>3.3 Check all connections.</p> <p>3.4 Apply different forward voltage and measure corresponding forward current.</p> <p>3.5 Record results in tabular form.</p> <p>3.6 Connect circuit according to circuit diagram of reverse bias.</p> <p>3.7 Apply different reverse voltage and measure corresponding forward current.</p> <p>3.8 Record results in tabular form.</p> <p>3.9 Sketch the VI curves from collected data.</p> <p>3.10 Maintain the record of performed job.</p>	1	2
4	<p>Sketch waves of half-wave and full-Wave rectifier circuit</p> <p>4.1 Select meter, component, oscilloscope and materials.</p> <p>4.2 Complete circuit of a half wave rectifier according to the circuit diagram.</p> <p>4.3 Check the circuit before operation.</p> <p>4.4 Measure the input and output voltage and observe wave shapes in the oscilloscope.</p> <p>4.5 Sketch the input and output voltage wave shapes.</p> <p>4.6 Maintain the record of performed job.</p>	1	3
5	<p>Testing special diodes.</p> <p>5.1 Select different types of special diodes.</p> <p>5.2 Set the AVO meter in the ohm scale.</p> <p>5.3 Measure resistances for each of two terminals.</p> <p>5.4 Determine the condition (good and bad).</p> <p>5.5 Determine the different terminals.</p>	2	2

	5.6 Maintain the record of performed job.		
6	Identifying the type and terminals of bipolar junction transistor. 6.1 Select PNP and NPN bipolar junction transistors. 6.2 Take AVO and manufacturer's literature of transistor. 6.3 Identify transistor terminals. 6.4 Measure base-emitter and base-collector resistance. 6.5 Determine the specifications with the help of manufacturer's literatures. 6.6 Identify PNP, NPN transistors. Base, Collector and Emitter. 6.7 Maintain the record of performed job.	2	3
7	Determining input and output characteristics of a transistor in common emitter connection. 7.1. Select DC power supply units, AVO meters, circuit board, components, and required materials. 7.2. Construct the circuit. 7.3. Adjust the voltage to appropriate point. 7.4. Record input and output voltage and current. 7.5. Plot the curve with recorded data. 7.6. Determine the value of β . 7.7. Maintain the record of performed job.	2	2
8	Determine the Q- point of R-C coupled CE transistor amplifier. 8.1. Draw the circuit diagram for the experiment. 8.2. Collect tools, equipment and materials. 8.3. Make all the connections according to the circuit diagram. 8.4. Check the connections. 8.5. Energize the circuit and record the Collector emitter voltage and collector current. 8.6. Draw the load line and locate the Q-Point on the load line. 8.7. Maintain the record of performed job.	2	3
9	Determine the voltage gain of CE transistor amplifier. 9.1. Draw the circuit diagram of CE transistor amplifier. 9.2. Collect required tools, equipment and materials. 9.3. Make all the connections according to the circuit diagram. 9.4. Check the connections and Q-Point. 9.5. Energize the circuit and record the input and output voltage. 9.6. Calculate the voltage gain. 9.7. Maintain the record of performed job.	2	2
10	Demonstrate the frequency response of single stage R-C coupled CE transistor amplifier. 10.1. Draw the circuit diagram for the experiment. 10.2. Collect required tools, equipment and materials. 10.3. Make all the connections according to the circuit diagram. 10.4. Check the connections.	2	3

	10.5. Energize the circuit and record the data. 10.6. Draw the frequency response curve from the data. 10.7. Maintain the record of performed job.		
	Total	16	25

Necessary Resources (Tools, Equipment and Machinery):

Sl. No.	Item Name	Quantity
1	Soldering Iron with Stand, De-soldering gun, Third Hand, Hot air gun, Iron Sponge, AVO Meter, Flat screw driver, Philips screw driver, Cutting pliers, Nose pliers, Automatic multifunction wire stripper, Tester, Knife, Power extension board.	30 Nos
2	DC power Supply, Function generator, Oscilloscope, Analog Electronics Trainer, Power project board/ bread board, Center tap Transformer (220/12V, 2A, 5A)	10 nos
3	Diode, Resistor, Potentiometer, Inductor, Capacitor, Transistor, LED, Zener Diode, Photo Diode, Tunnel diode, Varactor diode, Schottky diode, Step-Recovery diode, PIN diode, LCD and Solar cell.	50 nos
4	Resin, Soldering lead, Soldering tip, Fixable wire, Wire Brush	as required

Recommended Books:

Sl No.	Book Name	Writer Name	Publisher Name & Edition
1	Principles Of Electronics	V. K. Mehta	S.Chand
2	Basic Electronics (Solid State)	B. L. Theraja	S. Chand

Website References:

Sl. No.	Web Link	Remarks
1	https://www.youtube.com/channel/	
2	https://youtu.be/qsWkA-5grogo	
3	https://youtu.be/eXyGIPrD5Qk	
4	https://you.be/f-WiulYIrow	

Subject Code	Subject Name	Period per Week		Credit
27012	Machine Shop Practice-1	T	P	C
		1	6	3

Rationale	<p>Diploma in Engineering Level students are required to acquire the knowledge and skill on concept of machine tools, Coolant & lubricants, basic lathe machine, Drilling machine, grinding machine, basic maintenance and lubrication system. By the completion of this course student will be able to perform different machine tools operation such as lathe machine operation, drilling machine operation, grinding machine operation. As such the knowledge of machine shop practice-1 the pre-requisite for these fields for effective discharge of their duties. These necessities the introduction of Mechanical Engineering subject in the curriculum of Diploma in Engineering level. The subject covers only such topics which will enable the diploma engineers to operate lathe machine, drilling machine, grinding machine and maintenance work and lubricating process of machine tools. Have been given more emphasis on practical aspect rather than theory in teaching learning approach.</p>
Learning Outcome (Theoretical)	<p>At the end of the course the students will be able to:</p> <ul style="list-style-type: none"> ▪ Recognize commonly used machine tools. ▪ Carry out the OSH practice of different machine tools. ▪ Describe the functions of commonly used machine tools. ▪ State setting and operating procedure of the machine tools and accessories.
Learning Outcome (Practical)	<p>At the end of the course the students will be able to</p> <ul style="list-style-type: none"> ▪ Perform setup and operation on lathe machine. ▪ Perform facing, plain turning, step turning, taper turning, knurling, parting off operation on lathe machine. ▪ Perform drilling, boring, reaming, screw threading operation on lathe machine. ▪ Perform center punch, leather punch on lathe machine. ▪ Perform setup and operation on drilling machine. ▪ Perform single point cutting tool & sharpen twist drill on pedestal grinder. ▪ Carry out wheel dressing exercise on both pedestal grinder and surface grinder. ▪ Assemble grinding wheel on machine spindle. ▪ Carry out simple maintenance procedures, including lubrication.

Detailed Syllabus (Theory)

Unit	Topics with contents	Class (1Period)	Final Marks
1.	<p>SAFETY PRACTICE OF MACHINE SHOP</p> <p>1.1 State Occupational Safety & Health (OSH).</p> <p>1.2 Explain principle of starting and stopping machine tools.</p> <p>1.3 State general safety precautions for man.</p> <p>1.4 Explain general safety precautions for machine.</p> <p>1.5 State safety precaution during lathe operation.</p> <p>1.6 State safety precaution during drilling machine operation.</p> <p>1.7 State safety precaution during grinding machine operation.</p>	2	4
2	<p>MACHINE TOOLS, CUTTING FLUID & LUBRICANT</p> <p>2.1 State machine tools.</p> <p>2.2 Classify commonly used machine tools.</p> <p>2.3 List essential features of commonly used machine tools</p> <p>2.4 Define cutting fluid.</p> <p>2.5 Explain the necessity of cutting fluid.</p> <p>2.6 Mention different types of cutting fluid.</p> <p>2.7 Mention the cutting fluid used in different metals.</p> <p>2.8 Define the lubricant.</p> <p>2.9 Classify commonly used lubricants.</p>	4	6
3	<p>BASIC OF LATHE MACHINE.</p> <p>3.1 State lathe machine</p> <p>3.2 Classify different types of lathe machines.</p> <p>3.3 Mention major components of lathe machine.</p> <p>3.4 Explain the function of different parts of lathe machine.</p> <p>3.5 Mention the accessories and attachments of lathe machine.</p> <p>3.6 List the specification of Lathe machine.</p> <p>3.7 Explain express basic calculations for speed, feed & depth of cut for lathe works & taper calculation.</p> <p>3.8 State Taper turning and its method.</p> <p>3.9 Describe single point cutting tools, and tool materials.</p> <p>3.10 Explain the single point cutting angles and their relevant functions.</p>	5	10
4	<p>DRILLING MACHINE.</p> <p>4.1 State drilling machine.</p> <p>4.2 Classify different types of drilling machine.</p> <p>4.3 Explain the function of different drilling machines.</p>	3	5

	<p>4.4 Mention major components of drilling machine.</p> <p>4.5 Explain work holding methods.</p> <p>4.6 Explain express basic calculations for speed and feed.</p> <p>4.7 Mention different types of twist drill and tool materials.</p>		
5	<p>GRINDING MACHINE.</p> <p>5.1 Define grinding machine.</p> <p>5.2 Explain different types of grinding machines.</p> <p>5.3 Distinguish among surface grinder, cylindrical grinder and pedestal/bench grinder.</p> <p>5.4 Mention operations for the pedestal and surface grinder.</p> <p>5.5 Describe different types of grinding wheels and bond uses.</p>	2	5
		16	30

Detailed Syllabus (Practical)

Sl.	Experiment name with procedure	Class (3 Period)	Total Marks
1	<p>SETUP AND OPERATE ON LATHE MACHINE.</p> <p>1.1 Follow Occupational Safety & Health (OSH) practices.</p> <p>1.2 Perform simple setup of machine, work piece, tool bit and set machine speed and feed.</p> <p>1.3 Clean & store tools & equipment.</p> <p>1.4 Maintain the record of perform task.</p>	1	2
2	<p>PERFORM FACING OPERATION ON LATHE MACHINE</p> <p>2.1 Follow Occupational Safety & Health (OSH) practices.</p> <p>2.2 Interpret drawing as per specification.</p> <p>2.3 Select & Collect tools and equipment as per job requirements.</p> <p>2.4 Setup job on machine</p> <p>2.5 Perform facing operation.</p> <p>2.6 Clean & store tools & equipment.</p> <p>2.7 Maintain the record of perform task.</p>	2	2
3	<p>PERFORM PLAIN TURNING OPERATION ON LATHE MACHINE.</p> <p>3.1 Follow Occupational Safety & Health (OSH) practices.</p> <p>3.2 Interpret drawing as per specification.</p> <p>3.3 Select & Collect tools and equipment as per job requirements.</p> <p>3.4 Setup work piece.</p> <p>3.5 Perform plain turning operation.</p> <p>3.6 Clean & store tools & equipment.</p> <p>3.7 Maintain the record of perform task.</p>	2	3
4	<p>PERFORM STEP TURNING OPERATION ON LATHE MACHINE</p> <p>4.1 Follow Occupational Safety & Health (OSH) practices</p> <p>4.2 Interpret drawing as per specification.</p> <p>4.3 Select & Collect tools and equipment as per job requirements.</p> <p>4.4 Setup work piece.</p> <p>4.5 Perform step turning operation.</p>	2	3

	4.6 Clean & store tools & equipment. 4.7 Maintain the record of perform task.		
5	PERFORM TAPER TURNING OPERATION ON LATHE MACHINE 5.1 Follow Occupational Safety & Health (OSH) practices. 5.2 Interpret drawing as per specification. 5.3 Select & Collect tools and equipment as per job requirements. 5.4 Setup work piece. 5.5 Perform taper turning operation. 5.6 Clean & store tools & equipment. 5.7 Maintain the record of perform task.	2	2
6	PERFORM KNURLING OPERATION ON LATHE MACHINE 6.1 Follow Occupational Safety & Health (OSH) practices. 6.2 Interpret drawing as per specification. 6.3 Select & Collect tools and equipment as per job requirements. 6.4 Setup work piece. 6.5 Perform knurling operation. 6.6 Clean & store tools & equipment. 6.7 Maintain the record of perform task.	1	2
7	PERFORM PARTING OFF OPERATION ON LATHE MACHINE 7.1 Follow Occupational Safety & Health (OSH) practices. 7.2 Interpret drawing as per specification. 7.3 Select & Collect tools and equipment as per job requirements. 7.4 Setup work piece. 7.5 Perform parting off operation. 7.6 Clean & store tools & equipment. 7.7 Maintain the record of perform task.	1	2
8	PERFORM DRILLING OPERATION ON LATHE MACHINE 8.1 Follow Occupational Safety & Health (OSH) practices. 8.2 Interpret drawing as per specification. 8.3 Select & Collect tools and equipment as per job requirements. 8.4 Setup work piece. 8.5 Perform drilling operation. 8.6 Clean & store tools & equipment. 8.7 Maintain the record of perform task.	1	2
9	PERFORM BORING OPERATION ON LATHE MACHINE 9.1 Follow Occupational Safety & Health (OSH) practices. 9.2 Interpret drawing as per specification. 9.3 Select & Collect tools and equipment as per job requirements. 9.4 Setup work piece. 9.5 Perform boring operation. 9.6 Clean & store tools & equipment. 9.7 Maintain the record of perform task.	1	2
10	PERFORM REAMING OPERATION ON LATHE MACHINE 10.1 Follow Occupational Safety & Health (OSH) practices. 10.2 Interpret drawing as per specification. 10.3 Select & Collect tools and equipment as per job requirements. 10.4 Setup work piece. 10.5 Perform reaming operation. 10.6 Clean & store tools & equipment. 10.7 Maintain the record of perform task.	1	2
11	PERFORM SIMPLE SCREW THREAD OPERATION ON LATHE MACHINE	2	3

	<p>11.1 Follow Occupational Safety & Health (OSH) practices.</p> <p>11.2 Interpret drawing as per specification.</p> <p>11.3 Select & Collect tools and equipment as per job requirements.</p> <p>11.4 Setup work piece.</p> <p>10.5 Perform simple screw thread operation.</p> <p>10.6 Clean & store tools & equipment.</p> <p>10.7 Maintain the record of perform task.</p>		
12	<p>PERFORM CENTER PUNCH ON LATHE MACHINE</p> <p>12.1 Follow Occupational Safety & Health (OSH) practices.</p> <p>12.2 Interpret drawing as per specification.</p> <p>12.3 Select & Collect tools and equipment as per job requirements.</p> <p>12.4 Setup work piece.</p> <p>12.5 Perform center punch operation.</p> <p>12.6 Clean & store tools & equipment.</p> <p>12.7 Maintain the record of perform task.</p>	2	3
13	<p>PERFORM LEATHER PUNCH ON LATHE MACHINE</p> <p>13.1 Follow Occupational Safety & Health (OSH) practices.</p> <p>13.2 Interpret drawing as per specification.</p> <p>13.3 Select & Collect tools and equipment as per job requirements.</p> <p>13.4 Setup work piece.</p> <p>13.5 Perform leather punch operation.</p> <p>13.6 Clean & store tools & equipment.</p> <p>13.7 Maintain the record of perform task.</p>	2	3
14	<p>PERFORM SINGLE POINT CUTTING TOOL ON PEDESTAL GRINDER.</p> <p>14.1 Follow Occupational Safety & Health (OSH) practices.</p> <p>14.2 Interpret drawing as per specification.</p> <p>14.3 Select & Collect tools and equipment as per job requirements.</p> <p>14.4 Setup work piece.</p> <p>14.5 Perform single point cutting tool.</p> <p>14.6 Clean & store tools & equipment.</p> <p>14.7 Maintain the record of perform task.</p>	2	3
15	<p>PERFORM SETUP AND OPERATION ON DRILLING MACHINE.</p> <p>15.1 Follow Occupational Safety & Health (OSH) practices.</p> <p>15.2 Perform simple setup of machine, work piece, tool bit and set machine speed and feed.</p> <p>15.3 Clean & store tools & equipment.</p> <p>15.4 Maintain the record of perform task.</p>	1	2
16	<p>SHARPEN A TWIST DRILL ON THE PEDESTAL GRINDER.</p> <p>16.1 Follow Occupational Safety & Health (OSH) practices.</p> <p>16.2 Interpret drawing as per specification.</p> <p>16.3 Select & Collect tools and equipment as per job requirements.</p> <p>16.4 Perform sharpen a twist drill.</p> <p>16.5 Clean & store tools & equipment.</p> <p>16.6 Maintain the record of perform task.</p>	2	3
17	<p>DRILL A NUMBER OF HOLES WITH APPROPRIATE DRILL BIT.</p> <p>17.1 Follow Occupational Safety & Health (OSH) practices.</p> <p>17.2 Interpret drawing as per specification.</p> <p>17.3 Select & Collect tools and equipment as per job</p>	2	3

	requirements. 17.4 Setup work piece. 17.5 Perform drill a number of holes. 17.6 Clean & store tools & equipment. 17.7 Maintain the record of perform task.		
18	CARRY OUT WHEEL DRESSING EXERCISE ON BOTH PEDESTAL GRINDER AND SURFACE GRINDER. 18.1 Follow Occupational Safety & Health (OSH) practices. 18.2 Select & Collect tools and equipment as per job requirements. 18.3 Perform wheel dressing. 18.4 Clean & store tools & equipment. 18.5 Maintain the record of perform task.	2	3
19	MOUNT GRINDING WHEEL ON MACHINE SPINDLE. 19.1 Follow Occupational Safety & Health (OSH) practices. 19.2 Select & Collect tools and equipment as per job requirements. 19.3 Mount grinding wheel on machine spindle with balancing. 19.4 Clean & store tools & equipment. 19.5 Maintain the record of perform task.	1	3
20	CARRY OUT SIMPLE MAINTENANCE PROCEDURES, INCLUDING LUBRICATION. 20.1 Follow Occupational Safety & Health (OSH) practices. 20.2 Produce a maintenance schedule common used in machine shop. 20.3 Carry out simple maintenance procedures, including lubrication.	2	2
	Total	32	50

Necessary Resources (Tools, equipment's and Machinery):

SI	Item Name	Quantity
01	Lathe with related accessories	25 no's
02	Drilling with related accessories	25 no's
03	Grinding with related accessories	2 5no's

Recommended Software:

SI	Name	Quantity
01	www.virtuallathe.co.nz	As Necessary

Recommended Books:

SI	Book Name	Writer Name	Publisher Name & Edition
01	MACHINE SHOP PRACTICE	SOMENATH DE	
02	BASIC MACHINE SHOP PRACTICE I & II	V. K. Tejwani	

03	MACHINE TOOLS(WORKSHOP TECHNOLOGY)	R.N. DATTA	New Central Book Agency(P) Ltd.
04	WORKSHOP TECHNOLOGY I, II & III	W. A. J Chapman	
04	SHOP THEORY	James Anderson, Earl E, Tatro	Mc Graw Hill Book Company Fifth Edition
05	TECHNOLOGY OF MACHINE TOOLS	By Steve Krar and Arthur Gill and Peter Smid and Robert J. Gerritsen	Mc Graw Hill Book 8 th edition

Website References:

Sl	Web Link	Remarks
01	https://blogpuneet.files.wordpress.com/2013/07/introduction-to-basic-manufacturing-processes-and-workshop-technology.pdf	
02	https://reddragonsoftware.co.nz/virtual-lathe-software/	

Subject Code	Subject Name	Period Per Week		Credit
27131	ENGINEERING THERMODYNAMICS	T	P	C
		3	3	4

Rationale	<p>Thermodynamics now provides essential concepts and methods for addressing critical twenty-first-century issues, such as using fossil fuels more effectively, fostering renewable energy technologies and developing more fuel-efficient means of transportation.</p> <p>Thermodynamics is a very important branch of both physics and chemistry. It deals with the study of energy, the conversion of energy between different forms and the ability of energy to do work.</p> <p>Thermodynamics is the study of the relationship between properties of heat, temperature, energy, and work. Laws of thermodynamics are the concepts of entropy and the Internal energy formula.</p> <p>Thermodynamics principles are used by mechanical engineers in the fields of heat conversion. Mechanical engineers use thermo-science to design engines and power plants, heating, ventilation and air conditioning (HVAC) systems, heat exchanger, heat sinks, radiators, refrigeration, insulation and others.</p> <p>Thermodynamics plays a major part in the design and analysis of automotive engines, rockets, jet engines, and conventional or nuclear power plants, solar collectors, and the design of vehicles from ordinary cars to aeroplanes.</p> <p>Thermodynamics gives the foundation for heat engines, power plants, chemical reactions, refrigerators, and many more important concepts that the world we live in today relies on.</p>
Learning Outcome (Theoretical)	<p>After completing the subject student will be able to</p> <ul style="list-style-type: none"> • Explain several fundamental concepts including closed system, control volume, boundary and surroundings, property, state and process. • State distinction between extensive, intensive properties and equilibrium. • Describe various types of units for specific volume, pressure and temperature. • Describe the relationship among the Kelvin, Rankine, Celsius, and Fahrenheit temperature scales. • Explain key concepts related to energy and the first law of thermodynamics. • Explain internal, kinetic, and potential energy, work and power, heat transfer and heat transfer modes, heat transfer rate, power cycle, refrigeration cycle, and heat pump cycle. • Distinguishing between steady-state and transient analysis, between mass flow rate and volumetric flow rate. • Develop appropriate engineering models for control volumes, with particular attention to analyzing components commonly encountered in engineering practice such as nozzles, diffusers, turbines, compressors, heat exchangers, throttling devices, and integrated systems that incorporate two or more components. • Explain key concepts related to the second law of thermodynamics.

Learning Outcome (Practical)	After undergoing the subject students will be able to <ul style="list-style-type: none">• Verify First of law of thermodynamics.• Verify Second of law of thermodynamics.• Compare Otto and Diesel cycles.• Compare various heat exchangers.• Identify four stroke Otto cycle Diesel cycle with engine• Perform mechanical equivalent with Joules Operator• Perform heat transfer mode.• Perform Rankin Cycle with steam turbine model.
-------------------------------------	---

Detailed Syllabus (Theory)

Unit	Topics with contents	Class (1 Period)	Final Marks
1	<p>Concepts of Thermodynamics</p> <p>1.1 Define thermodynamic, system, boundary, surroundings and the universe.</p> <p>1.2 Mention types of systems.</p> <p>1.3 Describe close, open, isolated, flow, non-flow systems.</p> <p>1.4 Mention the applications of thermodynamics in the engineering field.</p> <p>1.5 Explain the extensive & intensive properties of thermodynamics systems</p> <p>1.6 Mention the units of thermodynamics systems.</p> <p>1.7 State thermodynamic state, path, process, quasi-static process, reversible & irreversible process and Thermodynamics equilibrium.</p> <p>1.8 Define point function, path function and control volume.</p>	3	6
2	<p>Heat, Temperature and Pressure</p> <p>2.1 Define heat, temperature and pressure.</p> <p>2.2 Explain different types of heat, temperature scale and pressure.</p> <p>2.3 Mention the units of heat, temperature scale and pressure.</p> <p>2.4 Convert one unit to another unit of heat, temperature scale and pressure.</p> <p>2.5 Distinguish between heat and temperature.</p> <p>2.6 Explain heat is a low-grade energy and work is a high-grade energy.</p> <p>2.7 Solve problems on heat, temperature scale and pressure.</p>	3	6
3	<p>Zeroth Law and First law of thermodynamics</p> <p>3.1 State the Zeroth law of thermodynamics.</p> <p>3.2 Mention the First law of thermodynamics.</p> <p>3.3 Describe the First law of thermodynamics</p> <p>3.4 Explain the limitation of First law of thermodynamics.</p> <p>3.5 State the corollaries of First law of thermodynamics.</p> <p>3.6 Describe the first law closed system application.</p> <p>3.7 Describe the first law open system application.</p>	3	5
4	<p>Second law of thermodynamics</p> <p>4.1 State the 2nd law of thermodynamics.</p> <p>4.2 Explain the 2nd law of thermodynamics.</p> <p>4.3 Explain the limitation of 2nd law of thermodynamics.</p> <p>4.4 State the corollaries of 2nd law of thermodynamics.</p> <p>4.5 Describe the physical significance of 1st and 2nd law of thermodynamics.</p>	4	7

	<p>4.6 State the 3rd law of thermodynamics.</p> <p>4.7 Solve problems on the laws of thermodynamic.</p>		
5	<p>Internal energy and enthalpy of gases</p> <p>5.1 Define internal energy.</p> <p>5.2 Define enthalpy & specific enthalpy.</p> <p>5.3 Explain the internal energy of a gas heated at constant volume and constant pressure.</p> <p>5.4 Relate between internal energy and enthalpy.</p> <p>5.5 Explain Joule's law.</p> <p>5.6 Solve problems on change of internal energy and enthalpy of gases.</p>	3	6
6	<p>Thermodynamic processes of perfect gases</p> <p>6.1 State thermodynamic processes.</p> <p>6.2 Explain the flow processes and non-flow processes of gases.</p> <p>6.3 Describe the various non-flow thermodynamic processes with P-V and T-S diagrams.</p> <p>6.4 Determine the work done by the gases during the above process.</p> <p>6.5 Explain the steady and unsteady flow processes.</p> <p>6.6 Describe the steady flow energy equations.</p> <p>6.7 Solve problems on thermodynamic processes.</p>	3	6
7	<p>Entropy of perfect gases</p> <p>7.1 Define entropy.</p> <p>7.2 State the importance of entropy.</p> <p>7.3 Describe the principle of increase of entropy.</p> <p>7.4 Explain the relation between heat & entropy.</p> <p>7.5 Describe the general expression for change of entropy of a perfect gas during various thermodynamic processes.</p> <p>7.6 Solve problems on entropy of different thermodynamic processes.</p>	3	5
8	<p>Steam and Vapor</p> <p>8.1 Mention the three-state of a substance.</p> <p>8.2 Distinguish between steam and vapors.</p> <p>8.3 Discuss the triple point of a substance.</p> <p>8.4 List the properties of vapors.</p> <p>8.5 Explain the formation of steam at constant pressure.</p> <p>8.6 Describe wet steam, dry saturated steam, superheated steam, dryness fraction, specific volume of steam.</p>	3	6
9	<p>Thermodynamic cycles</p> <p>9.1 Define thermodynamic cycle.</p> <p>9.2 Classify the thermodynamic cycle</p>	3	6

	9.3 Explain the reversible and irreversible cycles.		
10	<p>Air standard cycles</p> <p>10.1 Define Air Standard Cycle.</p> <p>10.2 Describe the Carnot cycle with P-V and T-S diagrams.</p> <p>10.3 Calculate air standard efficiencies of Carnot cycles.</p> <p>10.4 State Otto cycle, Diesel cycle with P-V and T-S diagrams of conventional air cycles.</p> <p>10.5 Explain the air standard efficiency of Otto cycle, Diesel cycle.</p> <p>10.6 Compare Otto and Diesel cycles.</p> <p>10.7 Compare the theoretical Otto and Diesel cycles with the actual Otto and Diesel cycles.</p> <p>10.8 Solve problems on different air cycles.</p>	4	7
11	<p>Vapor power cycles</p> <p>11.1 Define vapor power cycle.</p> <p>11.2 Describe the Rankin cycle with incomplete evaporation and modified Rankine cycle with superheated steam.</p> <p>11.3 Define reheat, regenerative and reheat-regenerative vapor cycles.</p> <p>11.4 Explain the reheat, regenerative and reheat-regenerative vapor cycles with P-V and T-S diagrams.</p> <p>11.5 Distinguish among the reheat, regenerative and reheat-regenerative vapor cycles.</p> <p>11.6 Describe the binary vapor cycle and topping cycle.</p>	3	6
12	<p>Heat engine, refrigeration and heat pumps</p> <p>12.1 State heat engine, refrigeration and heat pump.</p> <p>12.2 Describe the reverse cannot cycle with P-V and T-S diagrams.</p> <p>12.3 Describe the vapor compression mechanical refrigeration cycle.</p> <p>12.4 Calculate the Coefficient of performance COP (heating & refrigerating)</p> <p>12.5 Describe the capacity of the refrigerating machine.</p> <p>12.6 Describe the vapor absorption refrigeration cycle.</p> <p>12.7 Solve problems on COP and TR.</p>	3	6

13	<p>IC engines</p> <p>13.1 Define IC engine.</p> <p>13.2 Classify the IC engine on the basis of different terms.</p> <p>13.3 Explain the terms bore and stroke, piston displacement, clearance volume and compression ratio.</p> <p>13.4 List the moving parts and stationary parts of an IC engine.</p> <p>13.5 Mention the function of stationary and moving parts of an IC engine.</p> <p>13.6 State the working principle of 2-stroke and 4-stroke SI & CI engines.</p> <p>13.7 Compare the 2-stroke and 4-stroke engines.</p>	4	6
14	<p>Heat transfer</p> <p>14.1 Explain the three modes of heat transfer.</p> <p>14.2 Distinguish among conduction, convection and radiation of heat.</p> <p>14.3 Explain Fourier's law of thermal conductivity.</p> <p>14.4 Explain Newton's law of cooling for convective heat transfer.</p> <p>14.5 State Stefan-Boltzmann law of heat radiation.</p> <p>14.6 Define heat exchanger.</p> <p>14.7 Classify heat exchangers.</p> <p>14.8 Explain Radiator, condenser and Evaporator of heat exchangers.</p>	3	6
15	<p>Boiler.</p> <p>15.1 Define boiler.</p> <p>15.2 Classification of boilers.</p> <p>15.3 Discuss the different types of boiler</p> <p>15.4 Mention the utility of boiler.</p> <p>15.5 State the operational procedure of boiler operation.</p> <p>15.6 Merits and demerits of fire tube and water tube boiler.</p> <p>15.7 Explain boiler efficiency.</p>	3	6
	Total	48	90

Detailed Syllabus (Practical)

Sl No	Experiment name with procedure	Class (3 Period)	Continuous Marks
1	<p>Verify First Law of thermodynamics with I.C. Engine</p> <p>1.1 Collect an IC engine and required tools & equipment's.</p> <p>1.2 Loosen nut-bolt and separate engine head.</p> <p>1.3 Identify the different pressure volume and</p>	1	2

	<p>temperature.</p> <p>1.4 Note down observation.</p> <p>1.5 Apply the First Law.</p> <p>1.6 Draw the PV and TS Diagram.</p> <p>1.7 Re-install engine head.</p> <p>1.8 Maintain the record of perform task</p>		
2	<p>Verify Second Law thermodynamics with I.C. Engine</p> <p>2.1 Collect an IC engine and required tools & equipment's.</p> <p>2.2 Loosen nut-bolt and separate engine head.</p> <p>2.3 Identify the different pressure volume and temperature.</p> <p>2.4 Note down observation.</p> <p>2.5 Apply the Second Law.</p> <p>2.6 Draw the PV and TS Diagram.</p> <p>2.7 Re-install engine head.</p> <p>2.8 Maintain the record of perform task</p>	2	3
3	<p>Verify the second law of thermodynamics with the refrigeration cycle</p> <p>3.1 Collect a Refrigerator and required tools & equipment's.</p> <p>3.2 open the back cover.</p> <p>3.3 Connect the combined pressure gauge to the compressor.</p> <p>3.4 Collect the data of different pressure and temperature.</p> <p>3.5 Note down observation.</p> <p>3.6 Apply the Second Law.</p> <p>3.7 Draw the PV and TS Diagram.</p> <p>3.8 Maintain the record of perform task</p>	2	3
4	<p>Compare Otto and Diesel cycles</p> <p>4.1 Collect a Petrol Engine.</p> <p>4.2 Collect a Diesel Engine.</p> <p>4.3 Collect Pressure gauge and Temperature gauge.</p> <p>4.4 Collect Temperature</p> <p>4.5 Identify the different pressure volume and temperature.</p> <p>4.6 Record the data</p> <p>4.7 Draw the PV and TS Diagram.</p>	2	3

	4.8 Maintain the record of perform task		
5	Compare radiators, evaporators and condensers of heat exchangers 5.1 Collect a Refrigerator from Lab. 5.2 Collect a Diesel Engine. 5.3 Connect the Pressure gauge and Temperature gauge to Refrigerator and diesel engine. 5.4 Collect the data of Temperature and pressure from required instrument. 5.5 Record the data 5.6 Compare heat exchange of different instrument from collect data. 5.7 Maintain the record of perform task.	2	3
6	Demonstrate the 4-stroke Otto Cycle with an engine 6.1 Collect a 4-stroke petrol engine model. 6.2 Operate crank handle up to piston move TDC position. 6.3 Observe piston at TDC position intake valve open & exhaust valve closed position. 6.4 Operate crank handle until end of suction stroke (Piston at BDC position). 6.5 Operate crank handle until end of compression stroke and observe piston and valves position. 6.6 Operate crank handle up to end of expansion stroke and observe piston and valves position. 6.7 Operate crank handle up to end of exhaust stroke and observe piston and valves position. 6.8 After one cycle complete then draw P-V diagram of Otto cycle. 6.9 Maintain the record of perform task.	2	2
7	Demonstrate the 4-stroke Diesel Cycle with an engine 7.1 Collect a 4-stroke diesel engine. 7.2 Operate crank handle up to piston move TDC position. 7.3 Observe piston at TDC position intake valve open & exhaust valves closed position. 7.4 Operate crank handle until end of suction stroke (Piston at BDC position). 7.5 Operate crank handle until end of compression stroke and observe piston and valves position. 7.6 Operate crank handle up to end of expansion	2	3

	<p>7.7 stroke and observe piston and valves position. Operate crank handle up to end of exhaust stroke and observe piston and valves position.</p> <p>7.8 After one cycle complete then draw P-V diagram of diesel cycle.</p> <p>7.9 Maintain the record of perform task.</p>		
8	<p>Determine the mechanical equivalent of heat by Joule's apparatus</p> <p>8.1 Collect a Joule's apparatus.</p> <p>8.2 Connect pressure pump with apparatus.</p> <p>8.3 Note the fluid pressure and volume.</p> <p>8.4 Create pressure by hand pumper.</p> <p>8.5 Note the fluid pressure and volume (at least 5 reading).</p> <p>8.6 Draw volume-pressure diagram & volume inverse pressure diagram.</p> <p>8.7 Maintain the record of perform task.</p>	1	2
9	<p>Demonstrate the heat transfer modes Conduction, convention and radiation with refrigerator</p> <p>9.1 Collect a Refrigerator.</p> <p>9.2 Note down Primary temperature.</p> <p>9.3 Apply heating or Cooling Process</p> <p>9.4 Write three modes final temperature.</p> <p>9.5 Maintain the record of perform task.</p>	1	2
10	<p>Observe Rankin cycle with a steam turbine model</p> <p>10.1 Collect a pot to produce Steam.</p> <p>10.2 Collect a burner for heat.</p> <p>10.3 Collect a turbine model.</p> <p>10.4 Observe different parts of turbine model.</p> <p>10.5 Apply the method of Rankin Cycle.</p> <p>10.6 Visit a related industry.</p> <p>10.7 Maintain the record of perform task.</p>	1	2
	Total	16	25

Recommended Books:

Sl	Book Name	Writer Name	Publisher Name & Edition
01	Engineering Thermodynamics	P.K. Nag,	Tata McGraw-Hill, New Delhi
02	Engineering Thermodynamics	R.K. Rajput,	Laxmi Publications, New Delhi
03	Fundamentals of Engineering Thermodynamics	R.Yadav	Central Publishing House, Allahabad.
04	Thermodynamics – An	Yunus Centel & Boles	Tata Mc Graw-Hill, New Delhi.

	Engineering Approach		
05	Thermodynamics	J.P. Holman	Tata Mc Graw-Hill, New Delhi.
6	Engineering Thermodynamics	Rogers G.F.C. & Mayhew Y.R.	Tata Mc Graw-Hill, New Delhi.

Necessary Resources (Tools, equipment's and Machinery):

SI	Item Name	Quantity
01	Socket Set	24 pc
02	Ring wrench	1 set
03	Combination wrench	1 set
04	Flat, Star Screw Driver	1 set
05	Diesel Engine Model	5 pc
06	Petrol Engine Model	5 pc
07	Refrigerator	5 pc
08	Air Compressor	5 pc
09	Radiator	5 pc
10	Evaporator	5 pc
11	Condenser	5 pc
12	Pressure Gauge	5 pc
13	Temperature Gauge	5 pc
14	Steam turbine model	5 pc

Website References:

SI	Web Link	Remarks
01	https://youtu.be/7iA6dkaXYoo	First law of thermodynamics
02	https://youtu.be/1OFIW8OXN6	First law of thermodynamic
02	https://youtu.be/WTtxlaeC9PY	2 nd law of thermodynamics
03	https://www.youtube.com/watch?v=w6VNUYIUV3s	2 nd law of thermodynamics
04	https://www.youtube.com/watch?v=FTSBtx5jhaY	Heat Transfer mode conduction..
05	https://www.youtube.com/watch?v=HpCvWuvCUoA	Mode of heat transfer
06	https://www.youtube.com/watch?v=le-z0mPfmZo	Rankine cycle of steam turbine
07	https://youtu.be/Wd29UzYHJt0	Otto Cycle
08	https://youtu.be/hclxVynxCyl	Diesel Cycle
09	https://youtu.be/TBEEt8x4nSo	Refrigeration Cycle
10	https://youtu.be/VqUAhrrW6UA	Joule's apparatus.

Subject Code	Subject Name	Period per Week		Credit
		T	P	
27231	REFRIGERATION CYCLES AND COMPONENTS	2	3	3

Rationale	<p>The REFRIGERATION & AIR CONDITIONING TECHNOLOGY is essential for modern life. Impact of RAC in the society is increasing gradually. The Refrigeration Cycles and Components is providing opportunity for the students to enhance basic knowledge and skills for modern comfortable life. Over the subject students enhance Conventional and non-conventional refrigeration cycles; Vapor compression refrigeration; Vapor absorption refrigeration; Vapor compression & Vapor absorption refrigeration cycles Components; Thermoelectric refrigeration; Ice refrigeration; Expendable refrigerant refrigeration; Refrigerant Recovery & Recycling; VRF & VRV System; Operation of vapor compression refrigeration cycle; Ammonia-water vapor absorption refrigeration system; water-lithium bromide absorption refrigeration system; components of vapor compression cycles; accessories and auxiliaries; Inverter & Voice Controls AC System; refrigerant & green house effects; Air Curtain, AHU, CCU and FCU in Air Conditioning system; refrigeration oil.</p>
Learning Outcome (Theoretical)	<p>After Completing the subject, students will be able to:</p> <ul style="list-style-type: none"> • State Classification and Differentiate Various types of Conventional & Non-Conventional Refrigeration Cycles • State the features of Vapor Compression and Absorption Refrigeration System. • Illustrate the Vapor Compression and vapor Absorption Refrigeration Cycle Components. • Explain the Accessories and Auxiliaries of Refrigeration Cycles. • Describe & Classify the Refrigerant Recovery & Recycling Systems. • State the Importance of VRF & VRV System. • Describe the Inverter & Voice Controls RAC Systems. • Explain the Characteristics of Refrigerant & Green House Effects. • Describe the Air Curtains, AHU, CCU, FCU. • Illustrate the Characteristics of Refrigerant Oil.
Learning Outcome (Practical)	<p>After undergoing the subject, students will be able to:</p> <ul style="list-style-type: none"> ▪ Identify the Components of Vapor Compression Refrigeration Cycle: ▪ Dismantle and Identify all the Major Working Parts of Seal type Reciprocating Compressor: ▪ Dismantle and Reassemble a Thermostatic Expansion Valve and Identify Internal Parts: ▪ Dismantle and Reassemble an Automatic Expansion Valve and Identify Internal parts: ▪ Identify the Different Refrigerants used in Present Situation by Pressure Temperature Method. ▪ Perform the Transfer Refrigerant from Storage Cylinder to Service Cylinder. ▪ Perform the Recover CFC-12, HCFC-22, HFC-134a and HFC-410A from refrigeration system by Active Method. ▪ Perform the Recover HFC 600a, HCFC-22, HFC-134a and HFC-410A from Refrigeration System by Passive Method.

Detailed Syllabus (Theory)

Unit	Topics with Contents	Class (1 Period)	Final Marks
1	<p>CONVENTIONAL & NON- CONVENTIONAL REFRIGERATION CYCLES</p> <p>1.1 List the various conventional and non- conventional refrigeration cycles.</p> <p>1.2 Mention advantages and disadvantages of vapor compression & vapor absorption refrigeration cycles</p> <p>1.3 Discuss the application of vapor compression & vapor absorption refrigeration cycles.</p> <p>1.4 Illustrate the thermoelectric refrigeration system</p> <p>1.5 Mention the advantages & disadvantages of thermoelectric refrigeration system</p> <p>1.6 State basic ice refrigeration & dry ice refrigeration method.</p> <p>1.7 Describe evaporative refrigeration system with its application.</p> <p>1.8 Describe air cycle refrigeration method.</p> <p>1.9 Describe the working principle of steam jet refrigeration & expendable refrigerant refrigeration with its application.</p> <p>1.10 State eutectic plate refrigeration method.</p>	4	8
2	<p>VAPOR COMPRESSION AND ABSORPTION REFRIGERATION SYSTEM</p> <p>2.1 Describe operating principle of vapor compression refrigeration system.</p> <p>2.2 Explain the operating principle of ammonia-water vapor absorption system.</p> <p>2.3 Describe the working principle of water- lithium bromide absorption system.</p> <p>2.4 Discuss the application of different vapor compression & vapor absorption refrigeration system.</p> <p>2.5 Distinguish between water ammonia and lithium bromide absorption system.</p> <p>2.6 Compare vapor compression and absorption refrigeration system.</p>	2	8
3	<p>VAPOR COMPRESSION AND ABSORPTION REFRIGERATION CYCLE COMPONENTS</p> <p>3.1 Mention the basic components of Compression and Absorption refrigeration cycles.</p> <p>3.2 Describe the types, construction and operation of compressors used in refrigeration cycles.</p> <p>3.3 Mention the specific application of different type's compressor.</p> <p>3.4 Explain bore, stroke, swept volume, clearance volume, total volume, compression ratio and capacity of compressor.</p> <p>3.5 Describe the types, construction, operation and application of each condenser.</p> <p>3.6 Describe the types, construction and operation of automatic, thermostatic, low side float valve, high side float valve, orifice and thermoelectric expansion device.</p> <p>3.7 Describe types, construction and operation and application of each evaporator.</p>	3	8
4	<p>ACCESSORIES and AUXILIARIES of REFRIGERATION CYCLES.</p> <p>4.1 State the meaning of accessories and auxiliaries of refrigeration cycles.</p> <p>4.2 List the important accessories used in refrigeration cycles.</p> <p>4.3 List few numbers of auxiliaries used in refrigeration cycles.</p> <p>4.4 Describe the function, construction and position of the strainer, filter drier, accumulator and flush chamber.</p> <p>4.5 Describe the function, construction and position of heat exchanger, pressure relief valve, service valve, receiver, oil separator, liquid indicator, liquid moisture indicator and solenoid valve.</p> <p>4.6 Describe the function, construction and position of reversing valve, check valve, bypass valve and sight glass.</p> <p>4.7 Describe the function, construction and position of safety valve, vibration</p>	2	8

	eliminator, bypass regulator, fusible plug and purge.		
5	REFRIGERANT RECOVERY & RECYCLING SYSTEMS 5.1 Define refrigerant recovery, recycling. 5.2 State the Classification of Refrigerant Recovery System. 5.3 Describe the procedure of vapor refrigerant recovery. 5.4 Explain the Active & Passive method of Refrigerant Recovery System.	2	4
6	VRF & VRV SYSTEM 6.1 Define VRF & VRV System in refrigeration cycles. 6.2 Differentiate between VRF & VRV System in refrigeration cycles. 6.3 Mention the advantage & disadvantage of VRF System. 6.4 Mention the advantage & disadvantage of VRV System. 6.5 Explain the basic working Principle of VRF & VRV System.	2	4
7	INVERTER & VOICE CONTROL RAC SYSTEMS. 7.1 Define Inverter AC System. 7.2 State the Voice Controls RAC Systems. 7.3 Mention the Operating System of Inverter AC System. 7.4 Illustrate the Working Principle of Voice Controls RAC Systems. 7.5 Explain the basic Maintenance of Inverter Type RAC System.	2	4
8	REFRIGERENT & GREEN HOUSE EFFECTS. 8.1 Define refrigerant. 8.2 Mention the types of refrigerant. 8.3 Explain CFCs and the effect of CFCs on environment and alternative of CFCs. 8.4 Explain ODS, Ozone layer and global warming. 8.5 Mention the ODP and GWP value of different types of refrigerant. 8.6 Describe CFC, HCFC, HFC, HC and HC-blend refrigerant and green house effects. 8.7 Explain halocarbons, azeotropics , zeotropics and natural refrigerant. 8.8 Explain saturation pressure-temperature table of refrigerant. 8.9 Mention the application of different types of refrigerant.	3	6
9	AIR COURTAIN, AHU,CCU and FCU 9.1 Define the Air Curtain, AHU, CCU and FCU in Air Conditioning system. 9.2 Describe the Air Curtain, AHU, CCU and FCU in air conditioning system. 9.3 State the maintenance system of the Air Curtain, AHU, CCU and FCU.	2	4
10	REFRIGERENT OIL 8.1 State Refrigerant Oil. 8.2 State the purpose of compressor oil. 8.3 Mention the different types of refrigerant oil. 8.4 Describe the properties of refrigerant oil. 8.5 Explain SAE viscosity number and ISO viscosity grade of refrigerant oil. 8.6 Mention the factors for selecting refrigerant oil. 8.7 Prepare a table of important refrigerant and refrigerant oil.	2	6
	Total	24	60

Detailed Syllabus (Practical)

Sl.	Experiment name with procedure	Class (3 Period)	Total Marks
1	Identify the Components of Vapor Compression Refrigeration Cycle. 1.1 Identify the components of refrigeration cycle. 1.2 Start the refrigeration system. 1.3 Measure suction and discharge pressure .	1	5

	<p>1.4 Observe temperature on discharge line, condenser, liquid line and suction line.</p> <p>1.5 Observe the effect of refrigeration cycle.</p> <p>1.6 Maintain the record of performed task.</p>		
2	<p>Operate Thermo-Electric Refrigeration System.</p> <p>2.1 Observe the position of heating and cooling side of the thermoelectric system.</p> <p>2.2 Start the system.</p> <p>2.3 Measure ampere of the cycle.</p> <p>2.4 Observe the temperature on cooling and heating element.</p> <p>2.5 Maintain the record of performed task.</p>	1	5
3	<p>Operate the Evaporative Refrigeration System.</p> <p>3.1 Identify the components of evaporative refrigeration cycle.</p> <p>3.2 Measure the voltage and ampere rating of the unit.</p> <p>3.3 Start the unit.</p> <p>3.4 Measure room temperature and the grill temperature of the unit.</p> <p>3.5 Observe performance of the unit.</p> <p>3.6 Maintain the record of performed task.</p>	1	5
4	<p>Observe Major Working Parts of Seal type Reciprocating Compressor.</p> <p>4.1 Identify the external parts of the Seal type compressor.</p> <p>4.2 Select compressor head, valve plate and compressor body.</p> <p>4.3 Mark compressor head, valve plate and compressor body.</p> <p>4.4 Dismantle the compressor.</p> <p>4.5 Identify the internal parts of the compressor.</p> <p>4.6 Observe the operation of the compressor.</p> <p>4.7 Assemble the compressor parts.</p> <p>4.8 Maintain the record of performed task.</p>	1	5
5	<p>Dismantle, Reassemble and Identify Internal Parts of a Thermostatic Expansion Valve.</p> <p>5.1 Identify the external parts of the thermostatic expansion valve.</p> <p>5.2 Dismantle the thermostatic expansion valve.</p> <p>5.3 Identify the internal parts of Thermostatic Expansion Valve.</p> <p>5.4 Reassemble the TEV.</p> <p>5.5 Maintain the record of performed task.</p>	1	5
6	<p>Dismantle, Reassemble and Identify Internal Parts an Automatic Expansion Valve.</p> <p>6.1 Identify the external parts of the automatic expansion valve.</p> <p>6.2 Dismantle the automatic expansion valve.</p> <p>6.3 Identify the internal parts.</p> <p>6.4 Reassemble the expansion valve.</p> <p>6.5 Maintain the record of performed task.</p>	1	5
7	<p>Identify the Different types of Refrigerants by Pressure Temperature Method.</p> <p>7.1 Mark 1, 2 & 3 on three different refrigerant cylinders.</p> <p>7.2 Measure room temperature.</p> <p>7.3 Measure the pressure of refrigerant cylinder 1, 2 & 3.</p> <p>7.4 Compare temperature pressure with the refrigerant temperature- pressure chart.</p> <p>7.5 Decide the name of the refrigerant of cylinder 1,2 & 3.</p> <p>7.6 Maintain the record of performed task.</p>	1	5
8	<p>Perform the Transfer Refrigerant from Storage Cylinder to Service Cylinder.</p> <p>8.1 Evacuate service cylinder</p>		

	<p>8.2 Measure weight of the service cylinder</p> <p>8.3 Connect hose between storage and service cylinder.</p> <p>8.4 Cool the service cylinder</p> <p>8.5 Purge connected hose</p> <p>8.6 Open the cylinder valve</p> <p>8.7 Observe weight of the service cylinder for required amount of refrigerant.</p> <p>8.8 Close the storage cylinder valve and service cylinder valve.</p> <p>8.9 Maintain the record of performed task.</p>	1	5
9	<p>Perform the Recover CFC-12, HCFC-22, HFC-134a and HFC-410A from refrigeration system by Active Method.</p> <p>9.1 Observe the pressure of the refrigerant of the refrigerating unit to be recovered .</p> <p>9.2 Connect charging hose with the recovery machine, recovery cylinder and the refrigerating unit to be recovered.</p> <p>9.3 Purge the connected hoses.</p> <p>9.4 Open the cylinder valve and the refrigerating unit valve .</p> <p>9.5 Start the recovery machine.</p> <p>9.6 Observe the suction pressure and close the cylinder valve until the pressure at zero.</p> <p>9.7 Stop the recovery machine</p> <p>9.8 Maintain the record of performed task.</p>	1	5
10	<p>Perform the Recover HFC 600a, HCFC-22, HFC-134a and HFC-410A from Refrigeration System by Passive Method.</p> <p>10.1 Cool the recovery cylinder by ice and water.</p> <p>10.2 Observe the pressure of the refrigerant of the refrigerating unit to be recovered.</p> <p>10.3 Connect charging hose with the recovery cylinder and the refrigerating unit to be recovered.</p> <p>10.4 Cool the recovery cylinder and set on a weighing scale.</p> <p>10.5 Open the valve of the refrigerating unit and purge the charging hose.</p> <p>10.6 Open the cylinder valve.</p> <p>10.7 Observe the pressure and close the valve till the pressure stands.</p> <p>10.8 Observe the weight and close the valves.</p> <p>10.9 Maintain the record of performed task.</p>	1	5
	Total	10	50

Necessary Resources (TOOLS, EQUIPMENT & MATERIALS OF RAC):

Sl	Item Name	Quantity
01	Sling Psychrometer	15 set
02	Digital Multimeter	15 set
03	Clamp Meter/Clip on AVO Meter	15 set
04	Window AC	10 pcs
05	Split Type Ac	15 pcs
06	Dehumidifier	10 set
07	Split Type Ac,	15 set
08	Humidifier,	15 set
09	Tube Bender	15 set
10	Reamer	10 pcs
11	Flaring Tool Set	10 set
12	Swagging Tool Set,	10 set
13	Brazing Alloy,	50 pcs
14	Hammer	20 pcs

15	Manifold & Gauge Set W/5 Ft Hoses	15 set
16	Ball Valves	10 set
16	R-134a , R600a, R-410A, R-32Refrigerant	15 cylinders
17	Capacitor 40/70 mfd	10 pcs
18	Service Wrench	25 pcs
19	Screwdrivers (Philip & Slotted)	10 pcs
20	Tape Rule Nut Drivers (1/4" & 5/16")	10 pcs
21	Wire cutter/stripper/crimper	10 pcs
22	Needle nose plier 10"	25 pcs
23	adjustable wrench 12"	25 pcs
24	adjustable wrench 18"	25 pcs
25	Safety glasses/goggles	30 pcs
26	10" Vice grip	15 pcs
27	Thermocouple (optional)	30 pcs
28	IR thermometer (optional)	25 pcs
29	Leather gloves	20 pcs
30	Sharpie Marker	10 pcs
31	Adjustable Joint Pliers	15 pcs
32	Allen Wrench Set	10 set
33	Flashlight with magnet or hook mount Pocket Knife or Box Cutter Screwdriver	10 pcs
34	Digital Camera	15 pcs
35	Set (Straight and Phillips)	25 pcs
36	Electronic leak detector	5 pcs
37	Recovery cylinder	10 pcs
38	Refrigerant scale	10 pcs
39	Tubing Cutter	25 pcs
40	Nut Driver Sets (standard and metric)	25 pcs
41	Screwdrivers	30 pcs
42	Core Removal Tool Pocket	10 pcs
43	12" Combination Square Recovery Machine	5 pcs
44	Speed Clean Coil Jet CJ-125 HVAC Coil Cleaner	10 pcs
45	Hose Gaskets (spares for manifold hoses)	30 pcs
46	Pocket Thermometer	30 pcs
6	Box Wrench Set	25 Set
48	Gas Welding Set	05 Set
49	Hand gloves, Safety shoe, Apron	15 Set
50	Lokring Set	10 Set
51	Recovery Machine	05 sets

Recommended Books:

SI	Book Name	Writer Name	Publisher Name & Edition
01	Fundamentals of Refrigeration	Billy C. Langley	Delmar, 1995
02	Modern Refrigeration and Air-conditioning	Althouse/Turnquest/Bracciano	Goodheart-Willcox Pub; 8th edition (June 1, 2000)
03	Basic Refrigeration and Air-conditioning	P N Ananthanarayanan	Tata McGraw-Hill Education, 2005

04	A Text Book of Refrigeration and Air-conditioning	R. S. Khurmi, J. K. Gupta	Eurasia Publishing House, 1992
05	Principle of Refrigeration	Roy J. Dossat	Prentice Hall, 1997
06	Industrial refrigeration Handbook	Wilbirt F stoecker	McGraw-Hill Publishing Company, 1983
07	A course in refrigeration and air conditioning	Arora Domkundwar	Paperback – 1 January 2018
08	Lubricants and lubrication Theomang and Wilfried Dresel	WILEW-VCH	

Website References:

Sl	Web Link	Remarks
01	https://books.google.com.bd/books/about/Fundamentals_of_Refrigeration.html?id=iDaXPQAACAAJ&redir_esc=y	
02	https://ia800706.us.archive.org/33/items/ModernRefrigerationAndAirConditioning/Modern_Refrigeration_and_Air_Conditioning.pdf	
03	https://books.google.com.bd/books?id=gniJE5IK0YAC&printsec=frontcover&source=gb_s_ge_summary_r&cad=0#v=onepage&q&f=false	
04	https://books.google.com.bd/books/about/A_Text_Book_of_Refrigeration_and_Air_con.html?id=MrBaGwAACAAJ&redir_esc=y	
05	https://books.google.com.bd/books/about/Principles_of_Refrigeration.html?id=iNNTAAAAMAAJ&redir_esc=y	
06	https://www.goodreads.com/book/show/2503455.Industrial_Refrigeration_Handbook	
07	https://www.amazon.in/Course-Refrigeration-Air-Condition-Environmental-Engineering/dp/B082D4Q61M	